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ABSTRACT

This study examined how three dimensions of college students' experiences affect critical thinking skills: (1) curricular exposure, (2) formal classroom and instructional experiences, and (3) out-of-class experiences. The study used a 1-year, longitudinal, panel study design using data collected as part of a pilot study for a national, longitudinal investigation of factors influencing learning, cognitive development, and orientations toward learning in college. The survey randomly selected 600 students from a population of about 4,500 freshmen students at a large, urban, commuter, research university in Fall 1991. Of these, 327 (54.5%) participated and 210 (64.2%) of these also participated in the follow-up component in Spring 1992. The initial survey used the Collegiate Assessment of Academic Proficiency and also gathered demographic, family, and educational background information. The follow-up instruments included the College Student Experiences Questionnaire. Results indicated that college experiences gave a 6 to 17 percent increase in critical thinking skills, that both class-related and out-of-class experiences made positive, significant contributions to critical thinking scores, and that the number of hours students spent studying and the number of non-assigned books read were positively related to gains in critical thinking. (Contains 46 references.) (JB)

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INFLUENCES AFFECTING THE DEVELOPMENT OF STUDENTS' CRITICAL THINKING SKILLS

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INFLUENCES AFFECTING THE DEVELOPMENT OF STUDENTS' CRITICAL THINKING SKILLS

Abstract

This study estimates the relative and unique effects on changes in critical thinking of three dimensions of students' college experience: curricular exposure, formal classroom and instructional experiences, and out-of-class experiences. Students' classroom/instructional and out-of-class experiences both make positive, statistically significant, and unique contributions to gains in critical thinking above and beyond students' precollege characteristics and level of critical thinking. Theoreticians have long speculated that students' academic and non-academic experiences jointly influence change, and this study supports that belief. The design and instruments in this study may be of interest to persons involved in assessment or the study of college impact.

INFLUENCES AFFECTING THE DEVELOPMENT OF STUDENTS' CRITICAL THINKING SKILLS

A relatively large body of evidence suggests that much of the factual material students learn during college may have a relatively short shelf-life after they leave (McLeish, 1968; Gustav, 1969; Blunt & Blizard, 1975; Brethower, 1977). Even if content material is not forgotten, however, it may soon become dated in many occupational and professional fields. Thus, higher education's claims to promoting student learning in the long run must be based on evidence that colleges and universities affect those learning skills that are likely to be enduring. It seems reasonable to suggest that critical thinking ability is one such enduring skill, that it is a central element in life-long learning, and that it is an appropriate (if not essential) skill for colleges and universities to develop among students.

Pascarella and Terenzini (1991) note that "critical thinking" has been defined and measured in a number of ways "but typically involves the individual's ability to do some or all of the following: identify central issues and assumptions in an argument, recognize important relationships, make correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority" (p. 118).

Although the definitions and measures of critical thinking vary across the available studies, the weight of evidence is generally consistent with respect to what does and does not influence gains in students' critical thinking abilities. These skills, for example, appear not to be differentially affected by a student's academic major. While Burns (1974), Bennett (1975-76), and King, Wood, and Mines (1990) all report differences across academic major fields, other studies (e.g., Pascarella, 1989; see also Pascarella & Terenzini, 1991) indicate these differences evaporate when precollege differences in students' academic aptitude or critical thinking skills are taken into account.

Nor is there much evidence that critical thinking abilities are influenced by specific instructional variables (see McMillan, 1987 for a review of this literature). Pascarella and Terenzini (1991) suggest that one possible explanation for the absence of significant effects may be that a semester- or quarter-long course experience may be too brief to produce any measurable impact.

While individual courses may not shape critical thinking, the number of courses taken in certain areas does appear to matter. For example, even after initial differences in aptitude or critical thinking ability are controlled, gains in critical thinking have been shown to be positively related to the number of science, music, literature, and art courses taken (Dressel & Mayhew, 1954; Pike, 1989; Pike & Phillippi, 1988; Pike & Banta, 1989). Evidence from Winter, McClelland, and Stewart (1981) indicates gains may also be related to the interrelatedness of the courses taken, not just their number. In their

study, students who followed a course of study that required the integration of ideas and courses across disciplines showed greater gains on a measure of critical thinking than did students who took the regular courses in the same general areas but without the integrative emphasis. Forrest (1982) reports similar evidence. James Ratcliff and Elizabeth Jones have also found that certain sequences and combinations of courses across a rich array of disciplines, rather than any particular curricular structure, were related to gains in analytical reasoning (Jones, 1992, p. 42).

Other instruction-related factors also seem to make a difference. Although precollege critical thinking levels were uncontrolled, Smith (1977, 1981) found that (across both individuals and classes) three kinds of instructor-influenced classroom interactions were consistently and positively related to gains in critical thinking: the extent to which faculty members encouraged, praised, or used student ideas; the amount and cognitive level of student participation in class, and the amount of interaction among the students in a course.

A growing body of evidence indicates a student's level of involvement both in and outside the classroom may have important effects on various forms of cognitive development, including critical thinking ability. For example, Gaff, Wilson, and their colleagues (Gaff, 1973; Wilson, Wood, & Gaff, 1974; Wilson, Gaff, Dienst, Wood, & Bavry, 1975) found level of student involvement in a variety of activities to be associated with several forms of cognitive development. A series of studies done at the State University of New York at Albany (e.g., Terenzini, Theophilides, & Lorang, 1984; Volkwein, Wright, & Agrotes, 1987; Terenzini & Wright, 1987) and a national study by Anaya (1989) all contain evidence of the effects of students' out-of-class experiences on various forms of higher-order cognitive functioning. The most specific evidence relating to critical thinking comes from Pascarella (1989), who found that while each of nine measures of students academic and social experiences (e.g., living on-campus, interactions with faculty and peers, time spent studying) were not significantly related to gains in critical thinking (net of precollege levels), an aggregated measure of student social and academic involvement was a significant predictor, suggesting that college's effects may be more cumulative and interrelated, rather than specific to any particular kind of experience.

Similarly, evidence is mounting that students interactions with their peers and with faculty members (primarily, but not exclusively outside the classroom) are positively related to gains in general cognitive abilities. Evidence on the roles of these major agents of socialization are given in Ory and Braskamp (1988), Pace (1987, 1990), Terenzini and Wright (1987), Pascarella and Terenzini (1978), Terenzini and Pascarella (1980), Endo and Harpel (1982, 1983), Baxter Magolda (1987), and others.

Virtually without exception, however, these and similar studies of the institutionally-controllable sources of influence on students' critical thinking skills have

adopted a segmented approach in their conceptual and methodological designs. For example, as may be apparent in the foregoing literature review, the role of the curriculum is studied separately from the influences of methods of instruction, both of which are examined independently of classroom climate or instructor behaviors, and all these academic sources of influence on critical thinking are assessed as if students' out-of-class experiences were unrelated to gains in critical thinking. In short, while each of these areas of influence has a modest-to-large research base, these sources of influence on critical thinking have been studied as if they were independent of one another.

This study estimates the relative importance of three sources of influence on students' critical thinking abilities during the first-year of college: students' course-taking activities, their formal instructional and classroom-related experiences, and their out-of-class experiences. The study's primary purpose is to estimate the extent to which critical thinking is shaped both independently and jointly by students' formal academic activities and out-of-class experiences.

METHODS

Conceptual Framework

The basic conceptual model for this study (see Figure 1) is longitudinal and draws upon many of the elements of recent conceptualizations of college impact (e.g., Astin, 1984; Pascarella, 1985; Tinto, 1975, 1987; Weidman, 1989). The model hypothesizes six sets of constructs defining a causal sequence that begins when students come to college with a wide array of educationally-relevant background characteristics. These precollege characteristics influence not only the outcomes of college directly, but also students' course-taking patterns, formal classroom experiences, and out-of-class experiences during college, which, in turn, also shape educational outcomes. The interplay between and among these sets of influences on learning takes place within a particular institutional context (e.g., organizational characteristics, structures, and policies). This study seeks to estimate the relative importance of students' curricular, classroom, and out-of-class experiences on learning-related attitudes and values after taking into account certain of the precollege characteristics of new students, including initial levels of interest in learning. (Because this is a single-institution study, the institutional context is constant for all students and, thus, cannot be a factor in differential change in students' critical thinking abilities.)

Design, Sample, and Data Collection

The study used a one-year, longitudinal, panel study design. Data were collected as part of a pilot study for a large, national, longitudinal investigation of the factors that influence learning, cognitive development, and orientations toward learning in college.

The population for the study was the approximately 4,500 students enrolled for six or more academic credit hours during their first semester (Fall, 1991) at a large, urban, Research I university in the midwest serving an undergraduate population composed primarily of commuters. Students were recruited by mail and from the population of students attending precollege orientation. They were advised they would be participating in a national longitudinal study and would receive a stipend for their participation. Students were also assured that the information they provided would be kept confidential and would never become part of their institutional records. The Fall, 1991 data collection required approximately four hours, and students were paid $35 for their participation. Students who participated in the Spring follow-up received a second stipend of $35 for their three and one-half hours of testing.

Of the approximately 1,150 new students who volunteered for the initial, precollege data collection, 600 were randomly selected to participate (the small initial sample size relative to the population reflects budgetary constraints on the pilot study). Of the 600 students selected, 327 (54.5%) actually did so, with 210 (64.2%) of those also participating in the subsequent follow-up data collection in the Spring of 1992 (the end of the students' first year). These 210 students were reasonably representative of the institution's population of new students, although there was some potential bias. While the trends were not statistically significant, students in the sample, compared with the population from which they were drawn, had somewhat higher academic aptitudes and were somewhat more likely to be white than students of color.

Variables

Fall 1991 data were collected using two instruments. The first was Form 88B of the Collegiate Assessment of Academic Proficiency (CAAP), developed by the American College Testing Program to assess selected general skills typically developed by students in the first two years of college (ACT, 1990). The total CAAP consists of five, 40-minute, multiple-choice test modules (reading comprehension, mathematics, writing, science reasoning, and critical thinking). The second instrument was specifically designed for this study and gathered information on students' demographic, family, and educational backgrounds, as well as other precollege characteristics.

The Spring, 1992 follow-up instruments included Form 88A of the CAAP, Pace's (1984) College Student Experiences Questionnaire (CSEQ) to measure students' first-year experiences in college, and a specially-designed follow-up survey form assessing aspects of students' first-year experiences not covered by the CSEQ.

Following the conceptual framework for this study four sets of independent variables and one dependent variable and were developed. The first set of independent variables consisted of students' precollege characteristics, treated as control variables in this study. That set included parents' combined formal education and total family

income, and students' race/ethnicity, gender, degree aspirations, and precollege scores on the CAAP Critical Thinking Module. The operational forms of all these control variables are given in Table 1. Examination of the distributions of the categorical variables (race/ethnicity, gender, and highest degree planned) indicated that the limited skewness present was unlikely to bias regression parameter estimates.

Insert Table 1 about here.

As explained in greater detail below, the results of this study are based on two, "reduced model" multiple regressions containing only those independent variables which preliminary analyses indicated were related to the dependent measure. Thus, not all variables used in these preliminary analyses were retained for the final analyses. Table 1 lists the variables (including item/scale content and metrics) in each of the three areas of institutional influence (the curriculum, class-related experiences, and out-of-class experiences) that were retained for the "reduced model" regressions on CAAP critical thinking scores. Table 2 lists the variables tested in the preliminary screening analyses but not retained for the final analyses.

Insert Tables 2 about here.

The dependent variable was critical thinking skills, as measured by the CAAP module of the same name. This module is a 32-item measure of students' abilities to clarify, analyze, evaluate, and extend arguments. The test consists of four passages that are representative of the kinds of issues commonly encountered in a postsecondary curriculum. A passage typically presents a series of subarguments that support a more general conclusion. Each passage presents one or more arguments and uses a variety of formats, including case studies, debates, dialogues, overlapping positions, statistical arguments, experimental results, or editorials. Each passage is accompanied by a set of multiple choice items. The KR-20 internal consistency reliability coefficients for the critical thinking test ranged from .81 to .82 (ACT, 1990, pp. 11-13, 33). For the follow-up data collection, Form 88A of the CAAP Critical Thinking Module was used (this form is psychometrically equivalent to that used in the Fall).

Analytical Procedures

The conceptual model underlying this study (see Figure 1) specifies causal relations among the three college experience variable sets. The analyses reported below were not intended to test those relations, but rather to estimate the unique and joint contributions of students' academic and out-of-class experiences to changes in students' orientations to

learning. Thus, hierarchical regression, rather than causal modeling, techniques were adopted.

Data analysis proceeded in two stages. In order to avoid inflated estimates of the proportion of the variance explained due to the large number of independent variables relative to the sample size, the first stage consisted of a series of ordinary least-squares (OLS) regressions to identify those variables within each college experience set (curriculum, class-related, and out-of-class experiences) that were statistically significant predictors of each outcome measure after controlling for students' precollege characteristics, but not controlling for students' precollege critical thinking ability levels or other college experience variables. These variables were left uncontrolled to avoid masking (through collinearity among the predictor variables) the possible influence of college experiences that might be of theoretical or practical interest in their own right. For the same reason, any college experience variable related to critical thinking at $p < .10$ was retained. Thus, to avoid overlooking any variable with potential theoretical or practical importance, the variable selection process was an inherently lenient one.

The second stage of analysis used ordinary least-squares multiple regression analysis to estimate the unique and joint proportion of the variance explained by each of the three (now reduced) college experience variable sets. To estimate the unique variance attributable to each category of variables, each of the three sets of college influence measures was entered into the regression after precollege characteristics and the other two college experience sets had been entered. The change in the value of the R^2 accompanying the entry of the last set reflects the magnitude of that variable set's unique (or net) influence on critical thinking ability above and beyond that attributable to students' precollege characteristics and all other college experience variables.

Estimates of the proportion of the total variance shared by the three college experience variable sets were derived arithmetically, not by the entry of a set of statistical (cross-product) interaction terms. Shared variance estimates were calculated by subtracting from the overall R^2 the sum of (a) the variance due to the precollege characteristics, and (b) the unique (R^2-Change) variance associated with each of the three college experience variable sets. Such an analytical approach produces conservative estimates of the influence of each set of experience variables in that any variance these experience variables share with students' background characteristics are attributed to the precollege characteristics set.

Students' precollege critical thinking ability could be expected to be the single-most powerful predictor of critical thinking skill at the end of the first year. Under such conditions, the probability was high that the influence of other predictor variables of theoretical or practical interest might be masked due to collinearity among the independent variables. Consequently, two "reduced model" regressions (i.e., containing only those variables identified in the first stage analyses) were run. In the first (the

"Out" model), precollege critical thinking ability was left uncontrolled. In the second (the "In" model), precollege critical thinking ability was included in the set of precollege characteristics (i.e., controlled). The two reduced models produce something approximating upper- and lower-bound estimates of the influence of each variable set. Inclusion of students' precollege level of critical thinking skills (the "In" model) probably underestimates college's influence, while exclusion of precollege critical thinking ability (the "Out" model) probably overestimates college's effects.

RESULTS

Table 3 reports the results of the two reduced-model regressions partitioning the total variance explained into that attributable to student's precollege characteristics and to each of the three college experiences variable sets. As can be seen there, the model with students' precollege critical thinking ability uncontrolled explained 30.1 percent of the total variance, while the model with that variable included explained 52 percent of the total variance. Both amounts are statistically significant at $p < .001$.

More important, students' course-related and out-of-class experiences both made unique and statistically significant (if modest) contributions to the variance explained above and beyond that attributable to students' precollege characteristics or other college experiences and regardless of whether initial critical thinking ability was taken into account. Above and beyond students' precollege characteristics, their college experiences explained an additional 7% to 17% of the variance in first-year gains in critical thinking (depending on whether precollege critical thinking skills were controlled). Interestingly, even with precollege critical thinking controlled, students' out-of-class experiences contributed as much to gains in critical thinking as did students' class-related experiences (2.9% and 2.5%, respectively). The number of courses students took in different areas was related to critical thinking at the end of the first year, but that effect disappeared when precollege critical thinking ability was controlled (the "In" model). As one would expect, the variance explained by students' class-related and out-of-class experiences was reduced (by about half) when precollege critical thinking ability was controlled.

Terenzini, Springer, Pascarella, and Nora (in press) found that these same three variable sets made modest shared contributions to the variance explained in two measures of students' orientations toward learning over and above that attributable to precollege characteristics or any single set of college experiences (range = 1.8% to 11.7%). The shared variance terms in this study, however, are virtually nil.

Table 4 reports the standardized regression coefficients (beta weights) reflecting the relative contributions of each component variable to the explanation of variance in year-end critical thinking ability. With or without precollege critical thinking skill controlled, one precollege characteristic, one class-related variable, and two out-of-class experience

variables had significant and unique effects on year-end critical thinking. Parents' education, the number of hours students spent studying and the number of non-assigned books they read during the year were all significantly and positively related to first-year gains in critical thinking. Students' relationships with their peers, however, was negatively related to gains in critical thinking. This variable is a single-item scale on which students are asked to rate their "relationship with other students, student groups, and activities" on a 7-point scale where 1 = "competitive, uninvolved" and 7 = "friendly, supportive, sense of belonging."

Several other college experience variables were significantly and uniquely related to year-end critical thinking ability in the "Out" model. Students' reports of the effectiveness of their instruction in social science courses and the number of science courses taken were both positively related to year-end critical thinking levels. The number of courses taken in mathematics and students' library experiences, however, were both significantly and negatively related to year-end critical thinking. None of these effects remained, however, when precollege critical thinking ability was controlled.

Limitations

This study is limited in several respects. First, it is based on data from a relatively small sample of students at a single institution who are probably not representative of any national population. Similarly, only a small number of these students lived in university-controlled housing; thus, the nature and impact of their college experiences may not be representative of those of students at residential institutions. These students, however, may well be representative of first-year students at similar commuter institutions. Second, the study examines change over only one year. It seems quite possible (even probable) that greater, cumulative changes in critical thinking skills may occur over the full course of students' college careers. This study, however, cannot address questions relating to either the magnitude of change over a longer period or whether the same college influences may also be salient in subsequent college years. Third, "critical thinking" is a complex construct, and a variety of definitions and ways of measuring it have been advanced (see, for example, McMillan, 1987). There is also some dispute over whether critical thinking is a general cognitive ability (as it is assumed to be in this study), or a skill that varies in its character across disciplines. Fourth, the measures of students' course-taking experiences (the number of courses taken in each of six general disciplinary categories) probably does not adequately reflect the effects of those courses (or the patterns among them) on changes in students' critical thinking skills. Finally, the measures of instructor effectiveness is based on students' perceptions of instructional competence and not on some more objective measure.

DISCUSSION AND CONCLUSIONS

Overall, the two, "reduced model" regressions explained 30% and 52% of the variance in critical thinking abilities, depending on whether precollege critical thinking skill was included in the model. Above and beyond students' precollege characteristics, their college experiences explained an additional 6% or 17% of the variance in first-year gains in critical thinking (again, depending on whether precollege scores were included in the model; both increments are statistically significant). It is important to note that students' class-related and out-of-class experiences both made positive, statistically significant, and unique contributions to freshman year-end critical thinking scores, even after controlling students' precollege characteristics (including initial critical thinking scores) and other collegiate experiences. Moreover, these unique contributions to gains in critical thinking were equal in magnitude. Net of all other variables, the courses students took during their first year were not related to gains in critical thinking abilities. As noted above, however, this finding may be artifactual, due more to the relatively imprecise measurement of curricular effects (i.e., number of courses taken was used instead of, say, coursework patterns).

As might be expected, the number of hours students spent studying and the number of non-assigned books read during the year were positively related to gains in critical thinking. In contrast, gains were negatively related to students' perceptions of the quality of their relationships with student peers. Students who characterized their relationships with other students as "competitive, uninvolved, . . . alienat(ed)" were more likely to show gains in critical thinking than were students who portrayed their peer relations as "friendly, supportive, (or) a sense of belonging." The data in this study do not permit confident explanation of this relation, but one might speculate that a sense of participation and belonging in a "friendly, supportive" peer environment may require a partial suspension (or at least not the encouragement) of one's critical (i.e., analytic) thinking skills. Supportive peer environments, one might suggest, are more likely to promote the development of tolerance, compromise, consensus-building, and an emphasis on shared similarities rather than differences. Initial differences in critical thinking abilities cannot be offered as an explanation inasmuch as the relation persisted even when those differences were statistically controlled.

One must, of course, be mindful of the constraints on the generalizability of these finding. Nonetheless, the fact that students' class-related and out-of-class experiences both had effects on gains in critical thinking that were unique, statistically significant, and comparable in magnitude -- even with precollege ability levels controlled -- is both theoretically and practically suggestive. The finding is conceptually important, we believe, inasmuch as theoreticians (e.g., Sanford, 1964; Chickering, 1969; Heath, 1968, 1978) have long suggested that students learn and change in holistic ways and as a consequence of multiple college influences. Pascarella and Terenzini (1991) found clear evidence that various dimensions of students' collegiate experiences influenced how

students learn and change, but they also noted that, almost invariably, these sources of influence had been studied independently of one another. They found no empirical evidence to support beliefs about the holistic effects of the college experience on student learning. The evidence from this study quite clearly indicates that changes in students' critical thinking abilities are shaped, independently, by what happens to them both in and out of the classroom. The findings of this study are consistent with those of Terenzini, Springer, Pascarella, and Nora (in press), who found similar unique class-related and out-of-class experience effects on students' attitudes toward learning. The two studies are not consistent, however, in that the earlier research also found a joint effect attributable simultaneously to students' course-taking, class-related, and out-of-class experiences above and beyond those attributable uniquely to any of those variable sets. No such joint effect was observed in this study.

These findings suggest that future research on college impacts will have to be more comprehensive in both conception and design. Failure to take into account the multiple sources of influence that span the entire college experience is likely to result in incomplete representations of the college experience, misunderstanding of the web-like character of college's effects on students, and the underestimation of the magnitudes of those effects.

From a practical point of view, these findings have important implications for how colleges and universities currently organize themselves and for how they structure students' learning experiences (e.g., the separation of academic and student affairs divisions). Institutional and academic program planning processes, these findings suggest, are more likely to be successful and effective if they take into account the potential for simultaneous contributions of students' class-related and out-of-class experiences on student learning. Gains in critical thinking appear to be a consequence of a variety of student experiences, not just those that are part of the formal instructional program. Ways must be found to overcome the artificial, organizational bifurcation of our educational delivery systems. Academic and student affairs units have common goals, and the evidence of this study suggests that students are more likely to benefit educationally if these units work together, rather than separately, in pursuit of those common goals.

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Table 1

Independent Variables in Critical Thinking Regression Model

Category/Variable

Precollege

Parents' Education: Sum of mother's and father's education on a 9-point scale, where 1 = grammar school or less and 9 = professional degree.

Total Family Income: 14-point scale, where 1 = less than $6,000 and 14 = $150,000 or more.

Race: 0 = nonwhite, 1 = white.

Sex: 0 = female, 1 = male.

Highest Degree Planned: 5-point scale, where 1 = none and 5 = doctoral degree (Ph.D., Ed.D., M.D., D.O., D.D.S., or D.V.M.).

Out-of-Class Experiences

Relationship with Students: CSEQ single-item rating of "Relationship with other students, student groups, and activities" on a 7- point scale, where 1 = "competitive, uninvolved, sense of alienation" and 7 = "friendly, supportive, sense of belonging."

No. of Non-Assigned Books Read: CSEQ single-item rating on a 5-point scale of the number of non-assigned books read during the current school year, where 1 = none and 5 = more than 20.

Class-Related Experiences

Hrs./Wk. Studying: Single-item rating on a 7-point scale where 1 = 0 hrs./wk. and 7 = more than 20 hrs./wk.

Instructor Effectiveness in Social Science: Single-item rating on a 5-point scale reflecting instructor's overall teaching effectiveness in the first course in social science taken at this college, where 1 = very poor and 5 = excellent.

A General Conceptual Model of College Influence on Student Learning

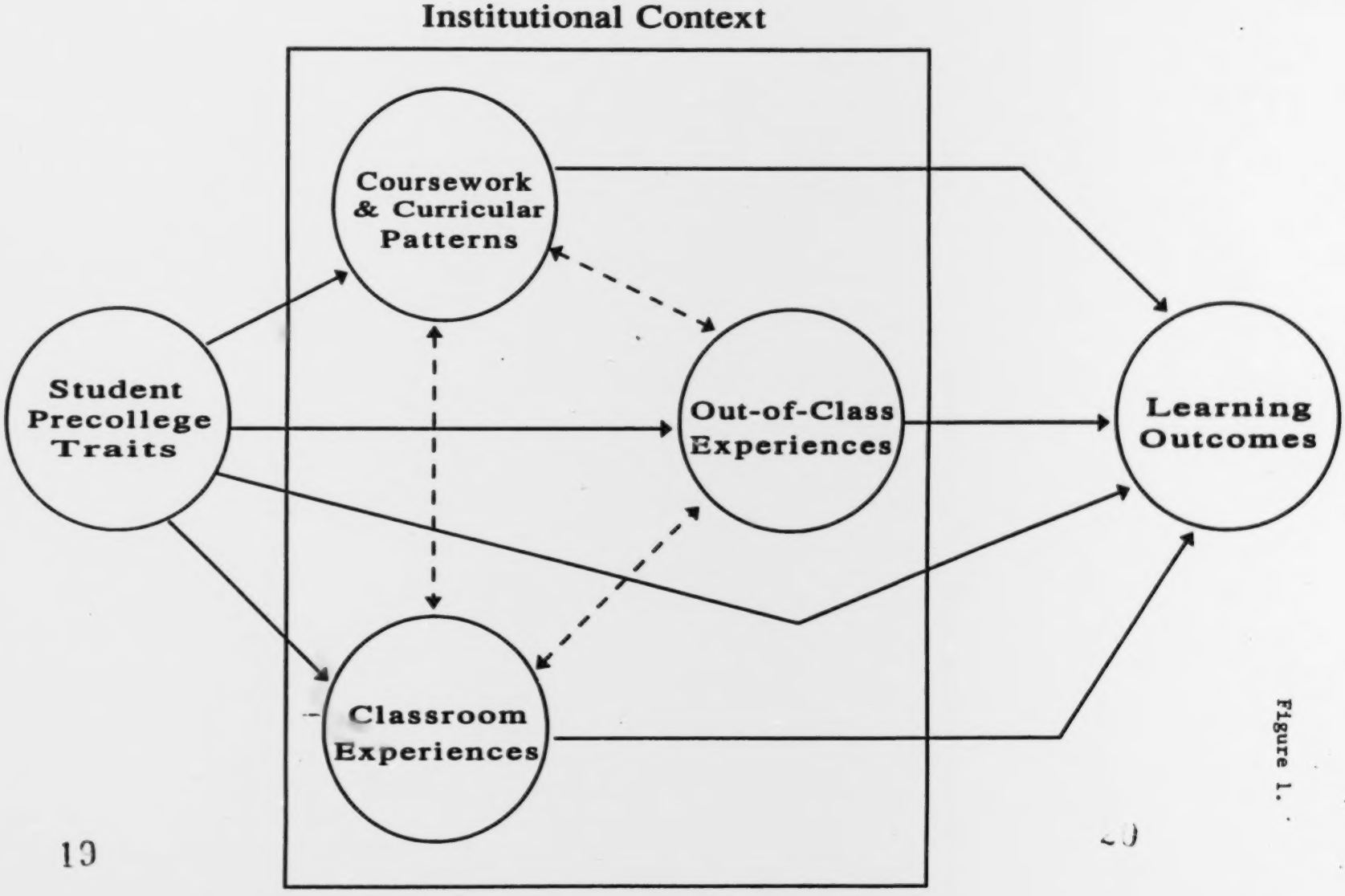

Figure 1.

Table 2

Independent Variables Dropped from Reduced Model

Category/Variable
Out-of-Class Experiences
Hours worked on-campus
Hours worked off-campus
Hours socializing with students
Hours talking with teachers outside of class
CSEQ scales:
Athletic and Recreation Facilities
Art, Music, Theater
Campus Residence
Student Union
Personal Experiences
Clubs and Organizations
Student Acquaintances
Topics of Conversation
Class-Related Experiences
Number of textbooks or assigned books read
Number of essay exams taken
Number of term papers or other written reports
Relationship with faculty
Instructor effectiveness in science
Instructor effectiveness in arts and humanities
Instructor effectiveness in mathematics

Table 1 (Continued)

Independent Variables in Critical Thinking Regression Model

Category/Variable
Class-Related Experiences (Continued)
Library Experiences: 10-item CSEQ "Library Experiences" scale reflecting students' experiences in libraries (e.g., "Used the library as a quiet place to read or study materials you brought with you" and "Used the card catalogue or computer to find what materials there were on some topic"). Scored on a 4-point scale, where 1 = never and 4 = very often. Alpha = .81.
Courses
Mathematics: Number of college courses taken in geometry, calculus, matrix algebra, statistics, accounting, business math, pre-algebra, or algebra.
Sciences: Number of college courses taken in astronomy, biology, botany, chemistry, engineering, geology, microbiology, physics, zoology, or other sciences.
Arts and Humanities: Number of college courses taken in drawing, art history, applied art, studio art, dance, theater, music appreciation, music performance, English literature, foreign language, humanities, philosophy, linguistics, classics, religious studies, or communications.

Table 3

Partitioning of Variance Results for Reduced-Model Regression on Critical Thinking

Variable	Out[a]	In[b]
Variance due to Precollege Characteristics	.131***	.456***
Unique[c] Variance due to:		
Out-of-Class Experiences	.069***	.029**
Class-Related Experiences	.050**	.025*
Courses Taken	.045**	.014
Total Shared Variance[d]	.006	.000
Total Variance Explained	.301***	.520***

[a]Precollege critical thinking score excluded from model.
[b]Precollege score on dependent variable included in model.
[c]Controlling for precollege characteristics and other college experience variable sets.
[d]Shared among the three college experience variable sets; statistical significance cannot be tested.

*p < .05. **p < .01. ***p < .001.

Table 2 (Continued)

Independent Variables Dropped from Reduced Model

Category/Variable
Class-Related Experiences (Continued)
CSEQ scales:
Experiences in Writing
Experiences with Faculty
Course Learning
Science
Courses
Number of college courses taken in:
composition or writing
social science
technical or preprofessional

Table 4

Beta Weights at Final Step for Reduced-Model Regression on Year-End Critical Thinking Ability

Variable	Out[a]	In[b]
Precollege		
Parents' Education (Sum)	.19**	.14*
Total Family Income	.06	-.00
Race	.12	.00
Sex	.10	.03
Highest Degree Planned	-.11	-.09
Initial Critical Thinking Ability		.54***
Out-of-Class Experiences		
Relationship with Students	-.17**	-.14**
No. Non-Assigned Books Read	.21***	.11*
Class-Related Experiences		
Hrs./Wk. Studying	.17**	.14**
Instructor Effectiveness in Soc. Science	.13*	.06
CSEQ Library Experiences Scale	-.13*	-.09
Courses		
No. in Mathematics	-.17*	-.11
No. in Sciences	.18*	.10
No. in Arts and Humanities	.12	.06

[a]Precollege critical thinking score excluded from model.
[b]Precollege critical thinking score included in model

*p < .05. **p < .01. ***p < .001.